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Chaimowiczia: a new Iuiuniscinae genus from Brazil (Oniscidea, Synocheta, Styloniscidae) with the description of two new troglobitic species

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Abstract

A new genus of Styloniscidae, *Chaimowiczia* **gen. nov.**, is described with two new species: *Chaimowiczia tatus* **sp. nov.** from Gruta do Padre cave (Santana, Bahia) and *Chaimowiczia uai* **sp. nov.** from Lapa d'água do Zezé cave (Itacarambi, Minas Gerais). The new genus and species were allocated into the subfamily Iuiuniscinae, hitherto monotypic, by the pronounced rectangular-shaped lateral pereonites epimera, dorsal surface smooth, body outline continuous without a gap between pereon and pleon, and pleonites 3 to 5 developed forming tips. The two species of *Chaimowiczia* gen. nov. differ in the shape of cephalon antennal lobes, pereonite 1 epimera, pleonite 5 posterior margin and uropod exopod and endopod proportion.

Keywords

amphibious isopods, Cave fauna, Isopoda, Neotropics, São Francisco basin

Introduction

The family Styloniscidae is currently composed of 16 genera (Boyko et al. 2020), grouped into four subfamilies: Styloniscinae Vandel, 1952, Notoniscinae Vandel, 1952, Kuscheloniscinae Strouhal, 1961 and Iuiuniscinae Souza, Ferreira & Senna,

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2015. Styloniscinae are the most representative, including 12 genera, some with pantropical distribution, while others are endemic to a single location (Dana 1852; Graeve 1914; Arcangeli 1930; Paulian de Félice 1950; Vandel 1952; Andersson 1960; Dalens 1989; Taiti and Xue 2012; Campos-Filho et al. 2014; Taiti and Montesanto 2020).

Most Styloniscidae species known in Brazil inhabit subterranean ecosystems, except for *Pectenoniscus angulatus* Andersson, 1960 and *Styloniscus spinosus* (Patience, 1907) (Lopes et al. 2005; Magrini et al. 2010; Campos-Filho et al. 2018). Styloniscidae species recorded in Brazilian caves belong to the subfamily Styloniscinae (*Spelunconiscus* Campos-Filho, Araujo and Taiti, 2014, *Xangoniscus* Campos-Filho, Araujo and Taiti, 2014, *Pectenoniscus* Andersson, 1960 and *Cylindroniscus* Arcangeli, 1929). Only one species of Iuiuniscinae has been recorded so far.

We present a new genus of Styloniscidae allocated into the subfamily Iuiuniscinae, with the description of two new species found in Brazilian caves. In addition to the taxonomic descriptions, this paper provides ecological and conservation information related to the new species and the subterranean ecosystems where they were found.

Materials and methods

The specimens were manually collected and fixed in 70% ethanol. They were measured and photographed with a ZEISS Axio ZoomV16 stereomicroscope coupled with an Axio Cam 506 Color camera, dissected and mounted in slides using Hoyer's medium in the Center of Studies on Subterranean Biology of the Federal University of Lavras (CEBS–UFLA, Lavras, Brazil). Drawings were made either from photographs or with the aid of a camera lucida coupled with the microscope Leica DM750. Illustrations were prepared using the software GIMP (v. 2.8) (Montesanto 2015, 2016). For analysis of the dorsal cuticular structures, pictures were taken using the scanning electron microscope Hitachi TM4000. Holotype and paratypes of the new species were deposited in the Subterranean Invertebrate Collection of Lavras (ISLA) in the Federal University of Lavras.

Taxonomy

Family Styloniscidae Vandel, 1952

Genus *Chaimowiczia* gen. nov.
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Type species. *Chaimowiczia tatus* sp. nov.

Diagnosis. Body non-volvational. Cephalon with antennal lobes, distinct supraantennal line bent in middle, vertex with lateral grooves. Body outline continuous with pereonites epimera well developed, widely separated, pleonites 1 and 2 bridge the gap

between pereon and pleon, pleonites 3–5 with epimera well developed. Telson with subtriangular distal half depressed with rounded apex. Antennula of three articles covered with setae, distal article with two apical aesthetascs. Antenna with flagellum of three distinct articles covered with setae. Mandibles *pars molaris* large and projected. Maxillula outer ramus with entire teeth and two long and thick setose stalks; inner ramus with three penicils at apex. Maxilla inner lobe wider than outer lobe. Maxilliped basis trapezoidal; endite bearing one penicil between two strong teeth. Pereopods with unbranched dactylar setae. Genital papilla lanceolate. Male pleopod 1 exopod and endopod subequal in length, endopod two-jointed, with flagelliform distal article. Male pleopod 2 endopod with two thickset articles, distal one tapering apically.

Etymology. The genus is named after Dr Flavio Chaimowicz, a physician who provided important contributions for the Brazilian speleology. Gender feminine.

Remarks. The diagnosis of Styloniscinae, Notoniscinae and Kuscheloniscinae has been presented in old publications that unfortunately include few characters of their members (Vandel 1952; Strouhal 1961). Meanwhile, more details have been provided for Iuiuniscinae (Souza et al. 2015). According to Vandel (1952: 95), Styloniscinae exhibit *i.* body smooth or tuberculated, without longitudinal ribs, and *ii.* pleon-epimera 1–5 narrow, with a gap between the pereon and pleon. For Notoniscinae, Vandel (1952: 95–96) noted *i.* pereonites dorsum tuberculated or with longitudinal ribs (sometimes with conspicuous protuberances also on the pleonites); *ii.* pleon-epimera 3–5 or 4–5 well developed, reducing the gap between the pereon and pleon; *iii.* genital tract of styloniscid type; *iv.* eyes with 3 ommatidia. For Kuscheloniscinae Strouhal (1961: 217) indicated the following: *i.* outline of pleon continuous with that of pereon; *ii.* pleon-epimera 3–5 very reduced; *iii.* anterior pereonites with protuberances and lateral ribs. Finally, Iuiuniscinae are characterized by *i.* dorsal integument smooth or without ribs or large protrusions; *ii.* enlarged epimera; *iii.* pereopod 1 much shorter than the others flanking the head; *iv.* pleon-epimera forming acute tips; *v.* telson distal half lower than the proximal half, and *vi.* habit to build mud shelters to molt and to protect juveniles (Souza et al. 2015). *Chaimowiczia* gen. nov. can be promptly distinguished from all the already described Styloniscidae by the pronounced rectangular-shaped lateral projections of pereonites, which is not observed in other members of this family. Moreover, tubercles are absent and the body outline is continuous without a gap between pereon and pleon. Epimera are developed in pleonites 3 to 5 forming tips, and telson distal half is narrower than the proximal half. Based on these characters, *Chaimowiczia* gen. nov. was allocated into the subfamily Iuiuniscinae.

Chaimowiczia gen. nov., as well as *Iuiuniscus*, occurs in the São Francisco River Basin and the caves are in the limestone plateaus of the Bambuí Group (Auler et al. 2001) (Fig. 1). The new genus resembles *Iuiuniscus* by the widely separated pereonites 1–7 epimera directed outwards, pleonites 3–5 epimera well developed; mandibles *pars molaris* large and projected. However, *Chaimowiczia* gen. nov. is not able to build mud shelters as *Iuiuniscus.* These genera also differ in the number of aesthetascs in antennula distal article (*Iuiuniscus* 12 *versus* 2 in *Chaimowiczia* gen. nov.), in the number of articles in antennal flagellum (*Iuiuniscus* 8 *versus* 3 in *Chaimowiczia* gen. nov.), teeth morphology in

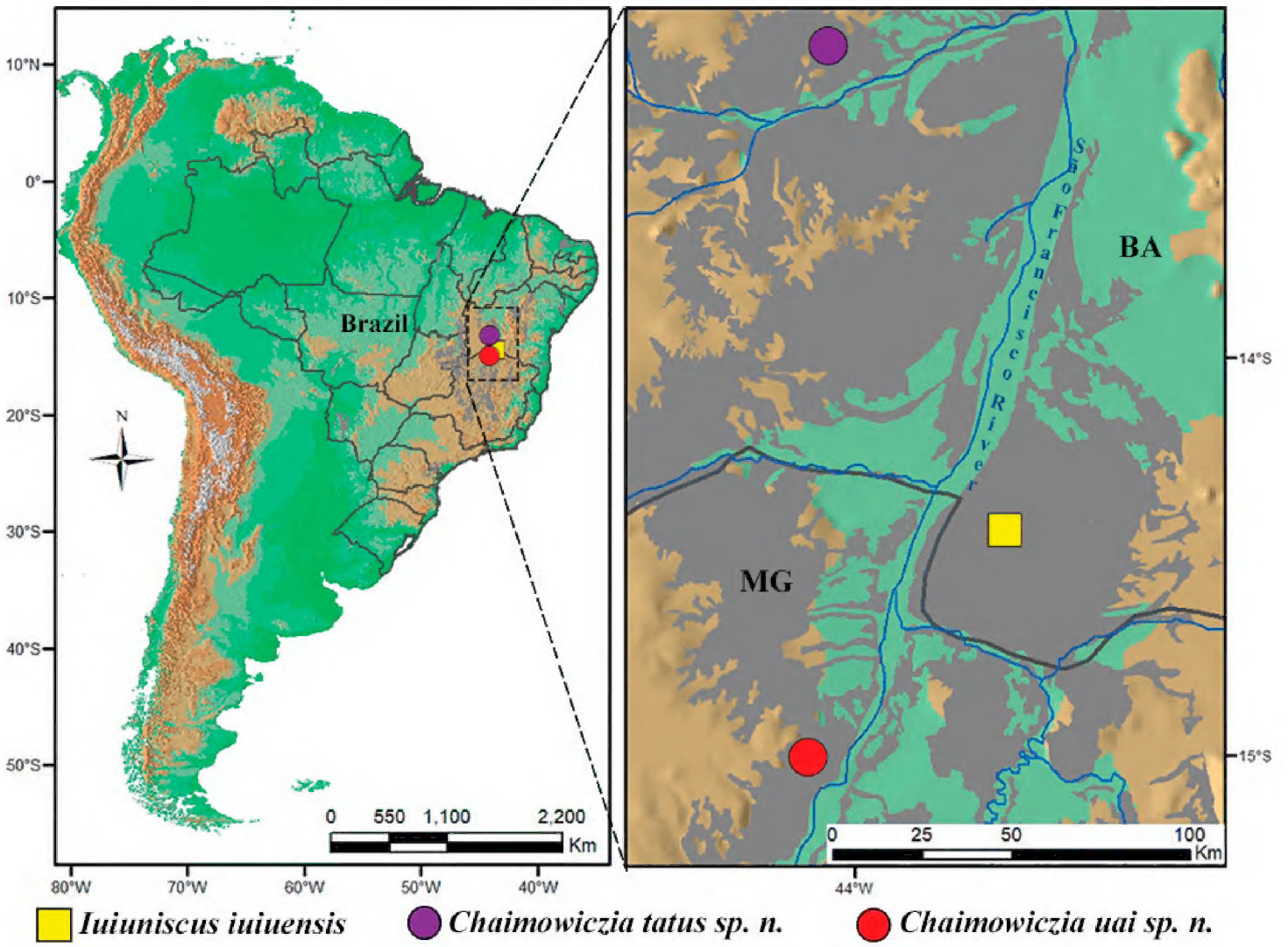

Figure 1. South America with the distribution of *Chaimowiczia* gen. nov. and *Iuiuniscus*. Delimited area in the states of Minas Gerais and Bahia states with the karst area of the Bambuí Group are represented in gray, rivers from São Francisco River Basin are represented in blue.

the maxillula outer ramus (outer group with curved teeth in *Iuiuniscus versus* straight in *Chaimowiczia* gen. nov.; inner group with two longer teeth in *Iuiuniscus versus* subequal in *Chaimowiczia* gen. nov.), male pleopod 1 exopod and endopod proportion (exopod longer than endopod in *Chaimowiczia* gen. nov. *versus* the opposite in *Iuiuniscus*), shape of male pleopod 1 exopod, shape of male pleopod 2 exopod (triangular in *Iuiuniscus versus* semicircular in *Chaimowiczia* gen. nov.), and notably by the morphology of pereon and pleon (with very prominent and very acute tips in pereon and pleon epimera in *Iuiuniscus* versus not so prominent nor so acute tips in *Chaimowiczia* gen. nov.).

Chaimowiczia tatus sp. nov.

http://zoobank.org/C9F67EAC-3104-44A1-B835-6580D9C83BFF
Figs 2–5

Material examined. ***Holotype.*** • 1 Male; Bahia, Santana, Gruta do Padre cave, -13.216325°, -44.065194°, 11 July 2014, leg. R. L. Ferreira, ISLA78105. ***Paratypes.*** • 1 female, same data as for holotype, ISLA78106; • 1 male 1 female, same locality as for holotype, 18 July 2019, ISLA78107.

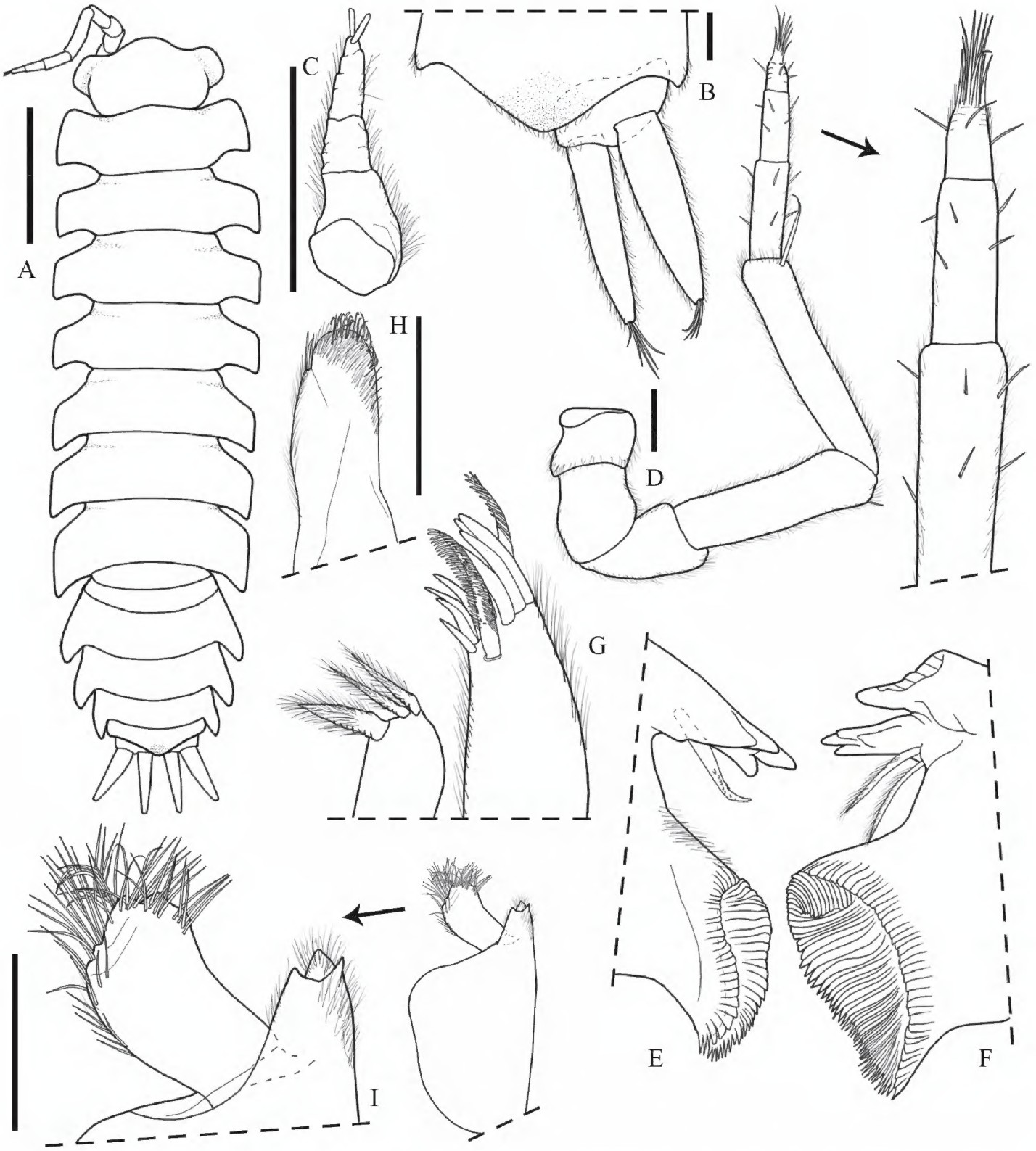

Figure 2. *Chaimowiczia tatus* sp. nov. Male **A** habitus, dorsal view **B** telson and uropod, dorsal view **C** antennula **D** antenna **E** right mandible **F** left mandible **G** maxillula **H** maxilla **I** maxilliped. Scale bars: 1 mm (**A**); 0.2 mm (**B–I**).

Diagnosis. *Chaimowiczia tatus* sp. nov. is characterized by pereonite 1 epimera directed sideways; quadrangular antennal lobes; pleonites 3–5 epimera tips well developed, pleonite 5 short, not surpassing the apex of telson; and uropods endopod and exopod subequal in length.

Description. Maximum length: male, 9 mm. Colorless, eyes absent (Figs 2A, 3A, B). Dorsal surface smooth covered with scale setae with short triangular base and long sensory sheathed hair (Fig. 3C). Cephalon (Fig. 3A, B) frons with distinct suprantennal line, downward and truncate in middle, quadrangular antennal

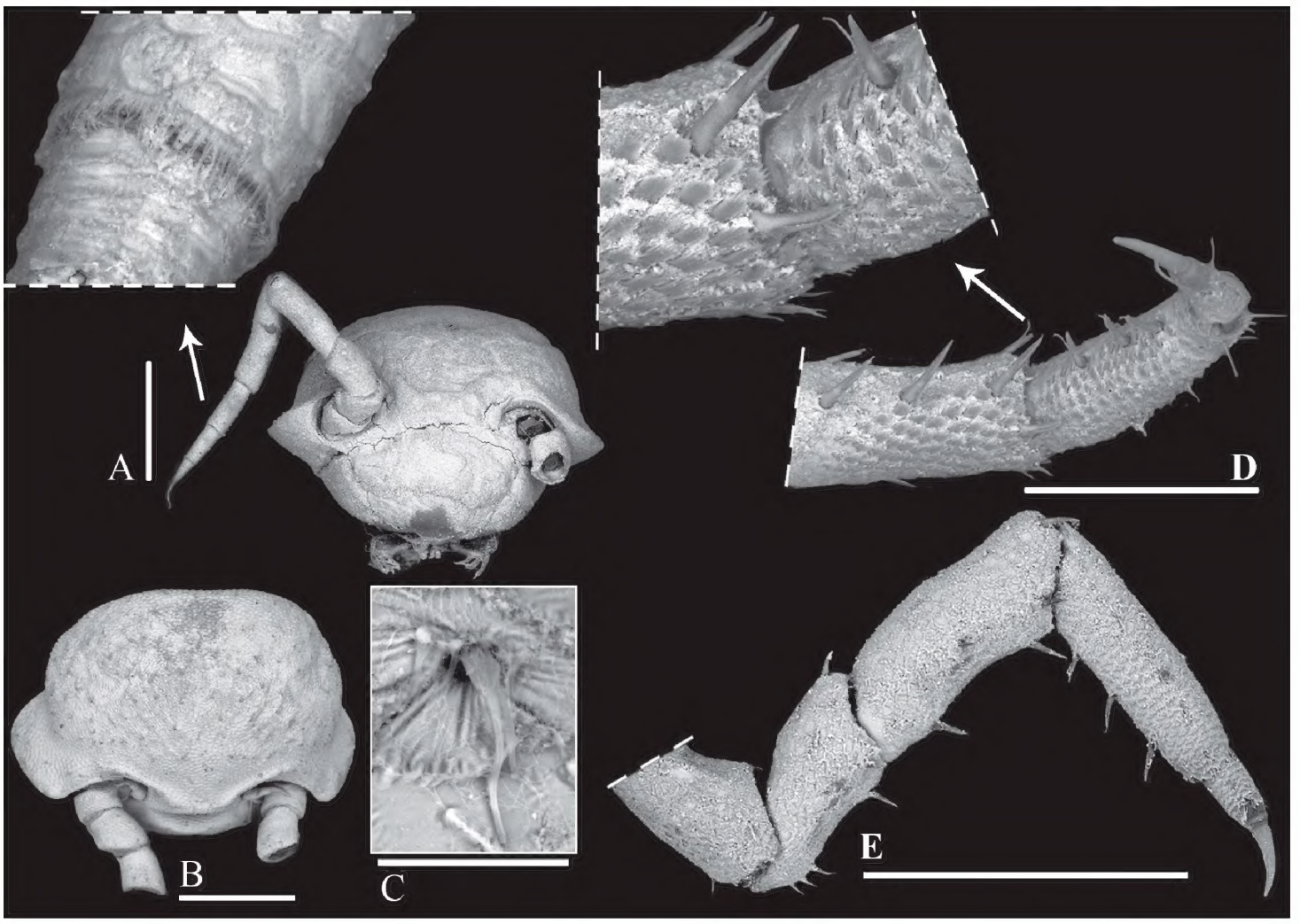

Figure 3. *Chaimowiczia tatus* sp. nov. Male **A** cephalon, frontal view **B** cephalon, dorsal view **C** pereopod 1 propodus, carpus and dactylus. Scale bar: 500μm (**A**); 200μm (**B**).

lobes. Body convex, pereonites 1–7 epimera quadrangular, widely separated and outwardly extended, pereonites postero-lateral corners progressively directed backward; pleon epimera 3–5 well developed (Fig. 2A). Telson (Fig. 2B) distal half subtriangular depressed with round apex. Antennula (Fig. 2C) with three articles covered with thin setae, distal article longer than second article, with two apical aesthetascs. Antenna (Figs 2D, 3A) surpasses pereonite 1 when extended backward, fifth article of peduncle as long as flagellum; flagellum with three articles. Right mandible (Fig. 2E) with one penicil; left mandibles with two penicils (Fig. 2F). Maxillula (Fig. 2G) outer ramus with 4 + 5 teeth, apically entire, and two thick plumose stalks; inner ramus with three penicils, proximal one stout. Maxilla (Fig. 2H) bilobate, inner lobe wider than outer lobe, with several thin and thick setae. Maxilliped (Fig. 2I) basis trapezoidal, distal portion slightly wider than basal; palp apex with tufts of setae; endite shorter than palp, setose, apex with one conic penicil between two strong teeth, inner tooth long. Pereopod 1 antennal grooming brush composed by pectinate scales longitudinally on frontal face of carpus and propodus (Fig. 4A), dactylus with one claw; pereopod 7 with water conducting scale rows. Uropod (Fig. 2B) protopod surpasses distal margin of telson; endopod and exopod subequal in length, inserted at the same level, covered with pectinate scales.

Male. Pereopods 1, 6 and 7 (Figs 4A–C) covered with setae; merus sternal margin with proximal tuft of setae. Pleopod 1 (Fig. 4D) protopod trapezoid, apex tapering;

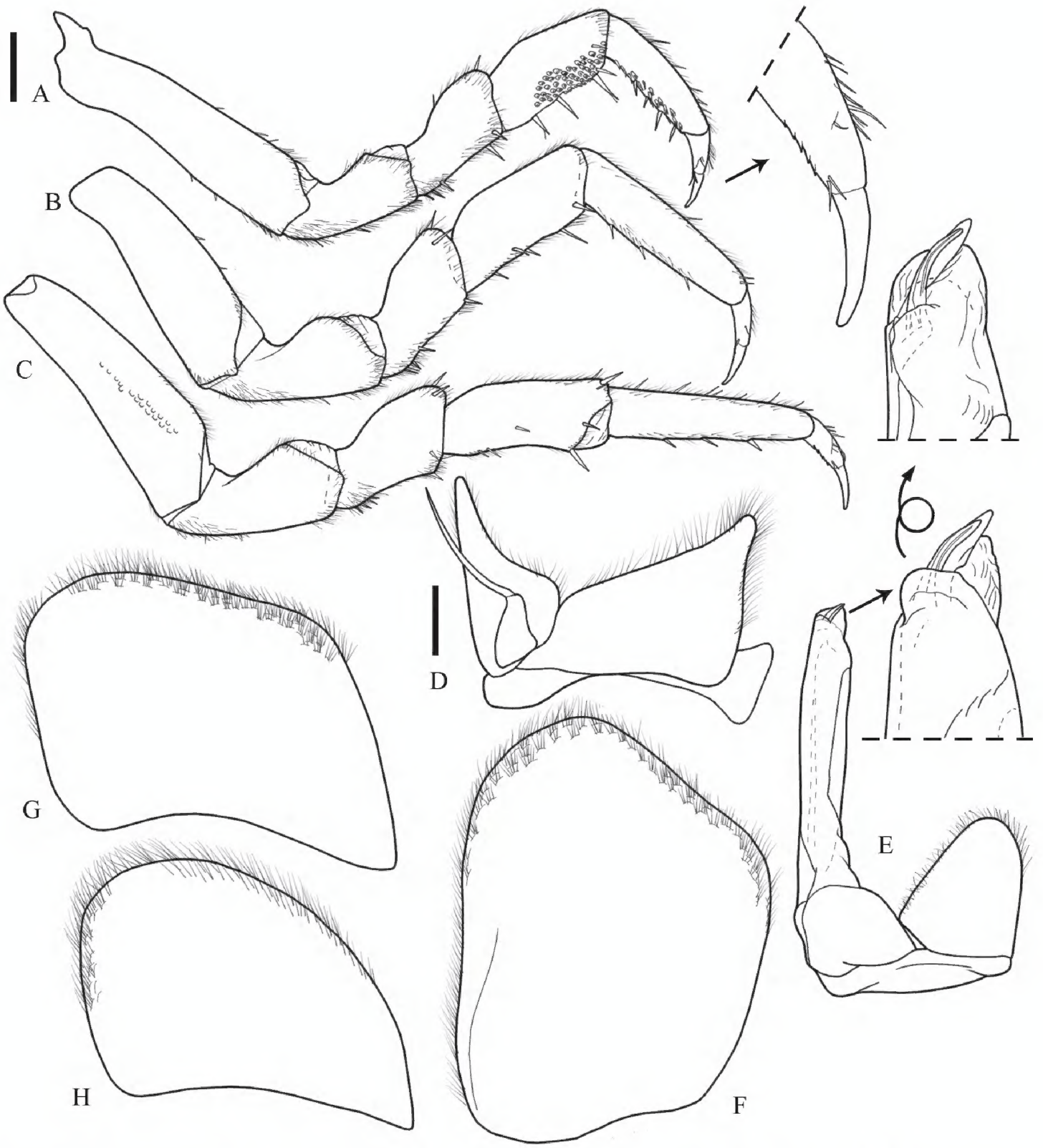

Figure 4. *Chaimowiczia tatus* sp. nov. Male **A** pereopod 1 **B** pereopod 6 **C** pereopod 7 **D** pleopod 1 **E** pleopod 2 **F** pleopod 3 exopod **G** pleopod 4 exopod **H** pleopod 5 exopod. Scale bars: 0.2 mm (**A**–**H**).

exopod covered with setae, triangular with sinuous external margin; endopod as long as exopod, with narrow basal article and flagelliform distal article. Pleopod 2 (Fig. 4E) exopod semi-oval, rounded distal margin, covered with setae; endopod of two articles, basal article quadrangular, shorter than exopod, distal article stout, apex with acute lobe directed outward. Pleopod 3 exopod (Fig. 4F) trapezoid, covered with thin setae on the distal portion and along the inner margin. Pleopod 4 exopod (Fig. 4G) rhomboid, wider than long, covered with thin setae. Pleopod 5 exopod (Fig. 4H) ovoid, wider than long, covered with thin setae.

Etymology. The epithet "*tatus*" refers to the "Tatus II project", an experiment of human permanency inside a cave held in 1987, conducted in Gruta do Padre cave.

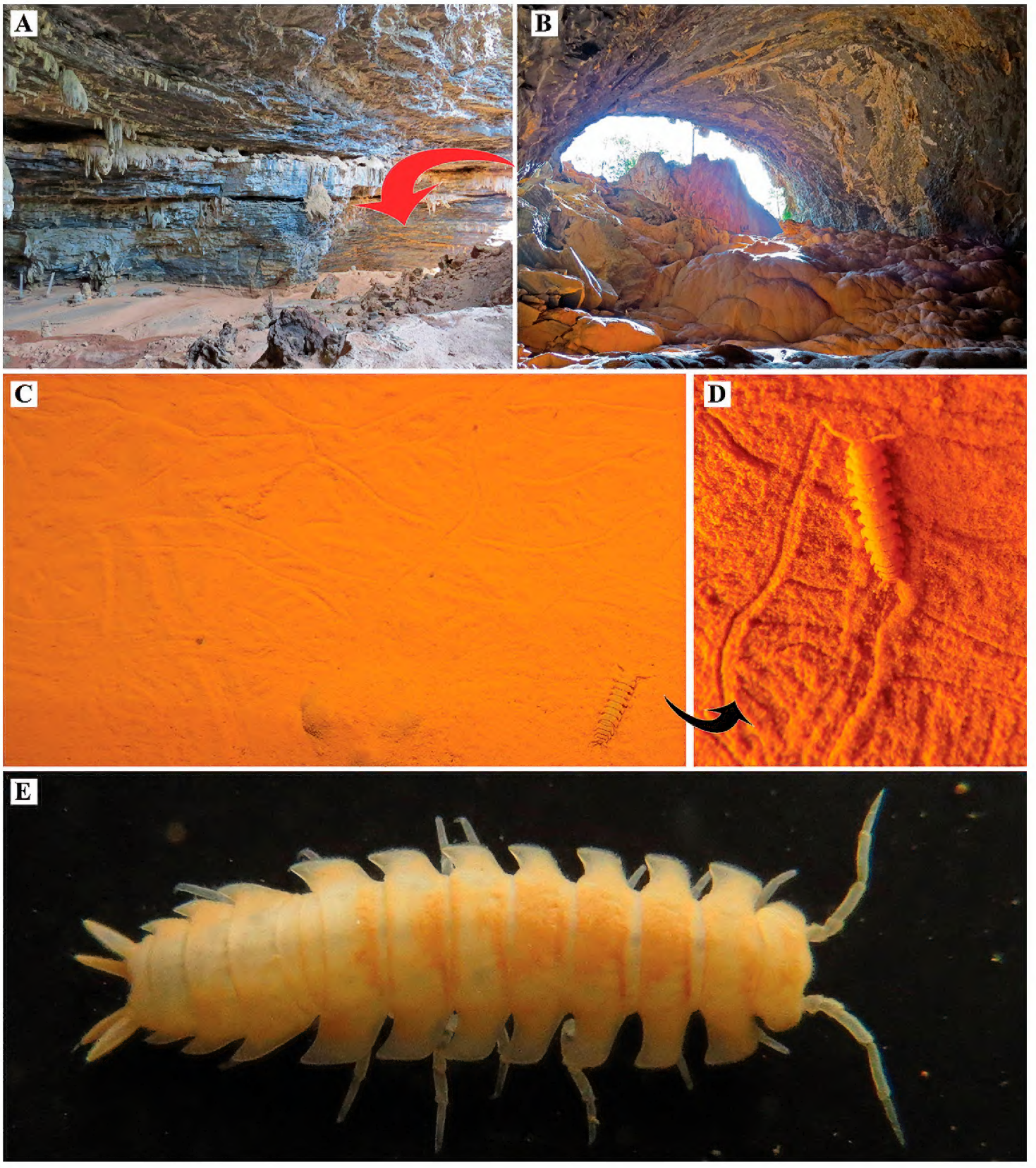

Figure 5. A Gruta do padre cave main entrance **B** rock shelter leading to cave main entrance **C** Pond where the species was collected **D** Substrate marked by the species activity **E** Living specimen of *Chaimowiczia tatus* sp. nov. with approximately 9 mm.

During the experiment, a group of speleologists stayed for 21 days inside the cave performing topographic and speleology surveys (Chaimowicz, 1987).

Ecological remarks. Gruta do Padre comprises an extensive cave with 16,400 m of horizontal projection and is currently considered the fifth longest cave in Brazil (Rubbioli et al. 2019). It presents two entrances and three distinct levels. A river flows in the lowest level, which is the most extensive. The main entrance comprises a huge rock shelter (Fig. 5A) that connects to a descending set of flowstones (Fig. 5A, B).

Specimens of *Chaimowiczia tatus* sp. nov. were observed in a single chamber in the second level (ca. 500 m from the main cave entrance), in clayish sediment pools (Fig. 5C–E). Two other troglobitic styloniscid species occur in this cave: one terrestrial (*Pectenoniscus santanensis* Cardoso, Bastos-Pereira, Souza & Ferreira, 2020a) and one new amphibious species. A peculiar condition is observed regarding the distribution of the two styloniscid species. While one species is amphibious, occurring in both aquatic and moist terrestrial habitats, *C. tatus* sp. nov. was observed exclusively underwater. The ponds where *C. tatus* sp. nov. occurs are devoid of the amphibious species, suggesting they might avoid each other. There are dozens of ponds along the lower conduit formed by the river overflow or by percolating water (especially in the case of travertine pools), where hundreds of individuals of the amphibious species were observed. However, no specimens of *C. tatus* sp. nov. were observed in the lower level coexisting with the other styloniscid. The ponds in which specimens of *C. tatus* sp. nov. occur usually present the substrate full of traces made by these individuals (Fig. 5C) indicating their high motility and activity. Since no visible organic matter was observed within the ponds (like bat guano or vegetal debris), they may be feeding on the substrate itself, which might be rich in microorganisms. Gruta do Padre Cave presents other troglobitic species: the beetle *Coarazuphium tessai* (Godoy & Vanin, 1990), the amphipod *Spelaeogammarus santanensis* Koenemann & Holsinger, 2000, and the millipede *Phaneromerium cavernicolum* Golovatch & Wytwer, 2004. All of them were discovered during the Tatus II experiment, demonstrating the relevance of this cave regarding the biota. Although some alterations were caused during the Tatus II experiment (in both the cave interior – a camping area was established inside the cave - and the external area), no impacts from past actions are currently visible. The external environment surrounding the cave was altered by the replacement of the native vegetation by pastures or crops. On the other hand, the inner portion of the cave is well preserved. Since the huge extension of the cave and the fact that only a few speleologists visit it each year (especially due to the difficult access), *C. tatus* sp. nov. does not seem to be currently threatened.

***Chaimowiczia uai* sp. nov.**

http://zoobank.org/94FB3A0F-1209-44E6-B2B4-033E95C1872C

Figs 6–9

Material examined. ***Holotype.*** • Male, Minas Gerais, Itacarambi, Lapa d'água do Zezé cave, -15.006745°, -44.117087°, 15 July 2019, leg. R. L. Ferreira, ISLA78108. ***Paratypes.*** • 2 males 1 female, same data as for holotype, ISLA78109; • 2 male 2 females, same locality as for holotype, 12 December 2014, ISLA78110.

Diagnosis. *Chaimowiczia uai* sp. nov. is characterized by the concave shape of pereonites epimera, with pereonite 1 epimeron directed frontward; round antennal lobes; pleonites 3–5 epimera with tips well developed, pleonite 5 surpassing apex of telson; and uropods endopod longer than exopod.

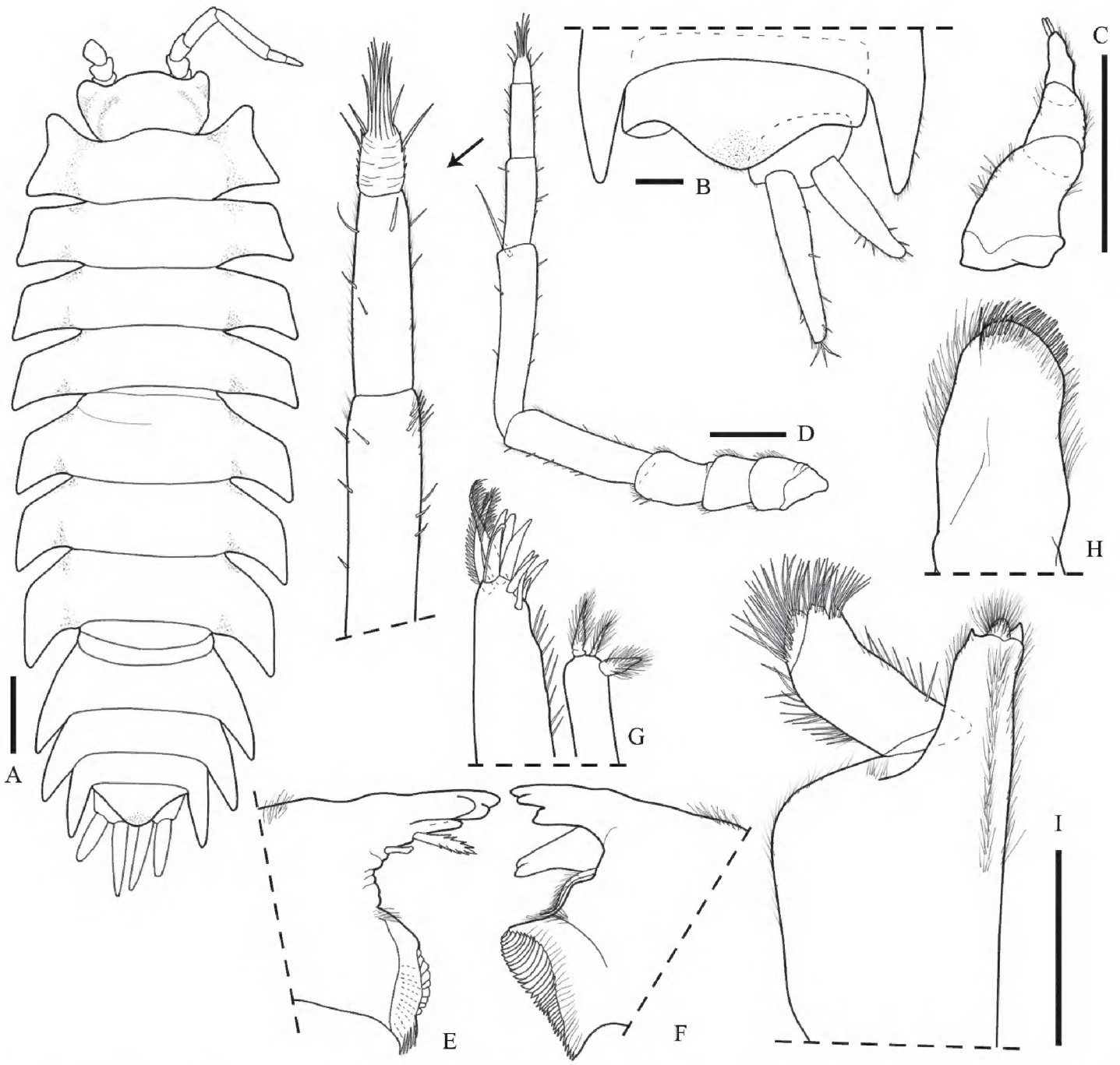

Figure 6. *Chaimowiczia uai* sp. nov. Male **A** habitus, dorsal view **B** pleonite 5, telson and uropod, dorsal view **C** antennula **D** antenna **E** right mandible **F** left mandible **G** maxillula **H** maxilla **I** maxilliped. Scale bars: 1 mm (**A**); 0.2 mm (**B, D–J**); 0.1 mm (**C**).

Description. Maximum length: male, 8 mm. Colorless, eyes absent (Fig. 6A, 7A, B). Dorsal surface smooth covered with scale setae with long base (reaching half the total length) and free sensory hair (Fig. 7C). Cephalon (Fig. 7A, B) vertex with lateral grooves; frons with distinct suprantennal line, downward in middle; round antennal lobes. Body convex; pereonite 1 postero-lateral corners well developed and projected forward, lateral margin concave; pereonite 7 slightly surpassing distal margin of pleonite 2; pleon 3–5 epimera well developed, pleonite 5 surpassing telson apex (Fig. 6A). Telson (Fig. 6B) with distal half subtriangular depressed, rounded apex. Antennula (Fig. 6C) with three articles covered with setae, distal article as long as second article, with two apical aesthetascs. Antenna (Fig. 6D) surpasses pereonite 1 when extended backwards, fifth article of peduncle shorter than flagellum; flagellum with three articles. Left mandible with two penicils (Fig. 6E); right mandible with one penicil (Fig. 6F). Maxillula (Fig. 6G) outer ramus with 5 + 5 teeth, apically entire, and

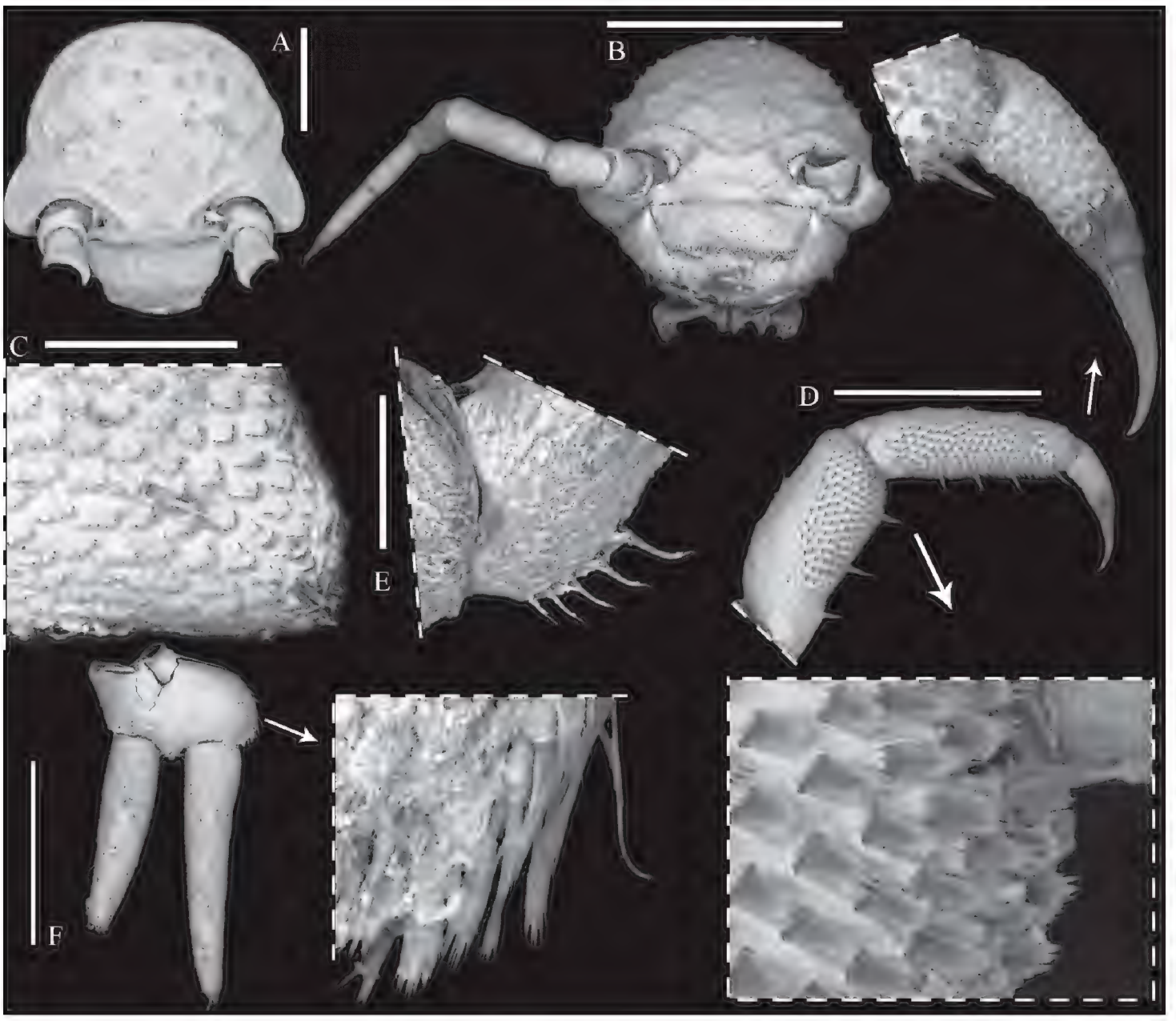

Figure 7. *Chaimowiczia uai* sp. nov. Male **A** cephalon, dorsal view **B** cephalon, frontal view **C** epimeron 1, dorsal view **D** pereopod 1 merus, propodus, carpus and dactylus **E** pereopod 2 merus **F** Uropod. Scale bars: 1 mm (**A**); 100μm (**B**); 400μm (**C**); 500μm (**D**).

two thick plumose stalks; inner ramus with three penicils, two of them stout. Maxilla (Fig. 6H) with bilobate apex, inner lobe wider than outer lobe with several setae on distal margin. Maxilliped (Fig. 6I) basis distal portion slightly wider than basal; palp apex with tufts of setae; endite rectangular, shorter than palp, setose, apex with one rounded penicil between two strong teeth, inner tooth longer. Pereopod 1 (Fig. 8C) antennal grooming brush composed by pectinate scales longitudinally on frontal face of propodus and carpus, dactylus with one claw; pereopod 7 basis with water conducting system scale rows. Uropod (Figs 6B, 7F) protopod surpasses distal margin of telson, covered with pectinate scales; endopod longer than exopod, inserted at the same level.

Male. Pereopods 1, 2 and 7 (Figs 7C, E; 8A, B) covered with setae; merus sternal margin concave with proximal hairy tuft of setae. Genital papilla (Fig. 8C) lanceolate. Pleopod 1 (Fig. 8C) exopod triangular with sinuous outer margin, covered with setae; endopod shorter than exopod, basal article narrow and flagelliform distal article; protopod trapezoidal, rounded apex. Pleopod 2 (Fig. 8D) exopod semicircular, rounded distal margin, covered with setae; endopod of two articles, basal article rectangular,

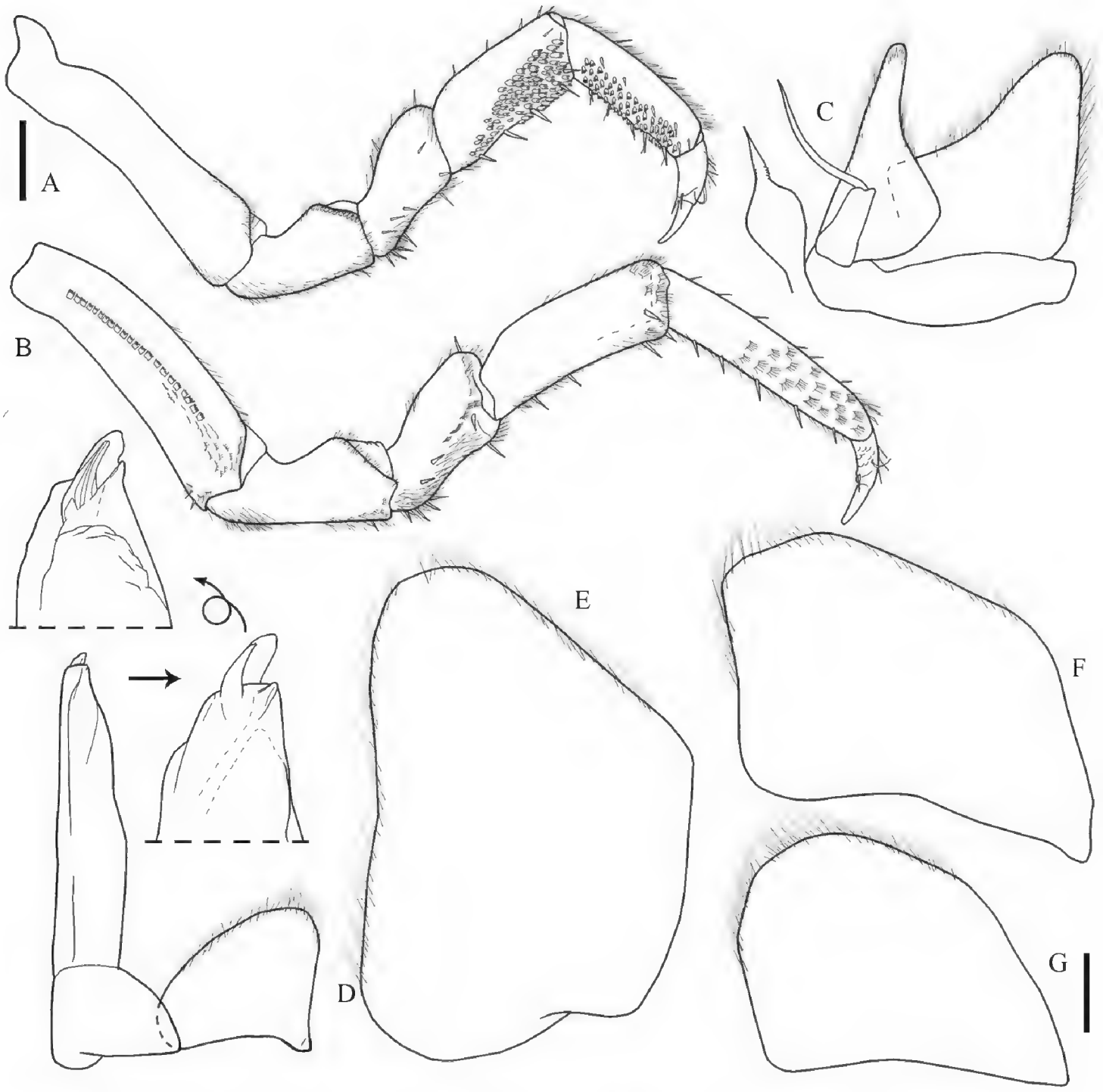

Figure 8. *Chaimowiczia uai* sp. nov. Male **A** pereopod 1 **B** pereopod 7 **C** genital papilla and pleopod 1 **D** pleopod 2 **E** pleopod 3 exopod **F** pleopod 4 exopod **G** pleopod 5 exopod. Scale bars: 0.2 mm (**A–H**).

shorter than exopod, distal article slender, directed backward, apex with distal projection. Pleopod 3 exopod (Fig. 8E) trapezoidal, distal margin straight covered with setae. Pleopod 4 exopod (Fig. 8F) rhomboid, wider than long. Pleopod 5 exopod (Fig. 8G) ovoid, wider than long.

Etymology. The epithet "*uai*" refers to the word often used by people from the state of Minas Gerais, Brazil, to express doubt, astonishment or surprise.

Ecological remarks. Lapa D'Água do Zezé cave is located at the border of Cavernas do Peruaçu National Park. Although most of the outcrop where the cave is inserted within the limits of the park, the cave entrance is outside the park's limit. The external landscape is composed of a well-preserved deciduous forest on the limestone outcrop and surroundings (Fig. 9A), which is inserted in a transition between two phytogeographic domains, Cerrado (Brazilian savannah) and Caatinga (mesophytic and xeromorphic forests). Lapa D'Água do Zezé is a labyrinthine cave with one horizontal

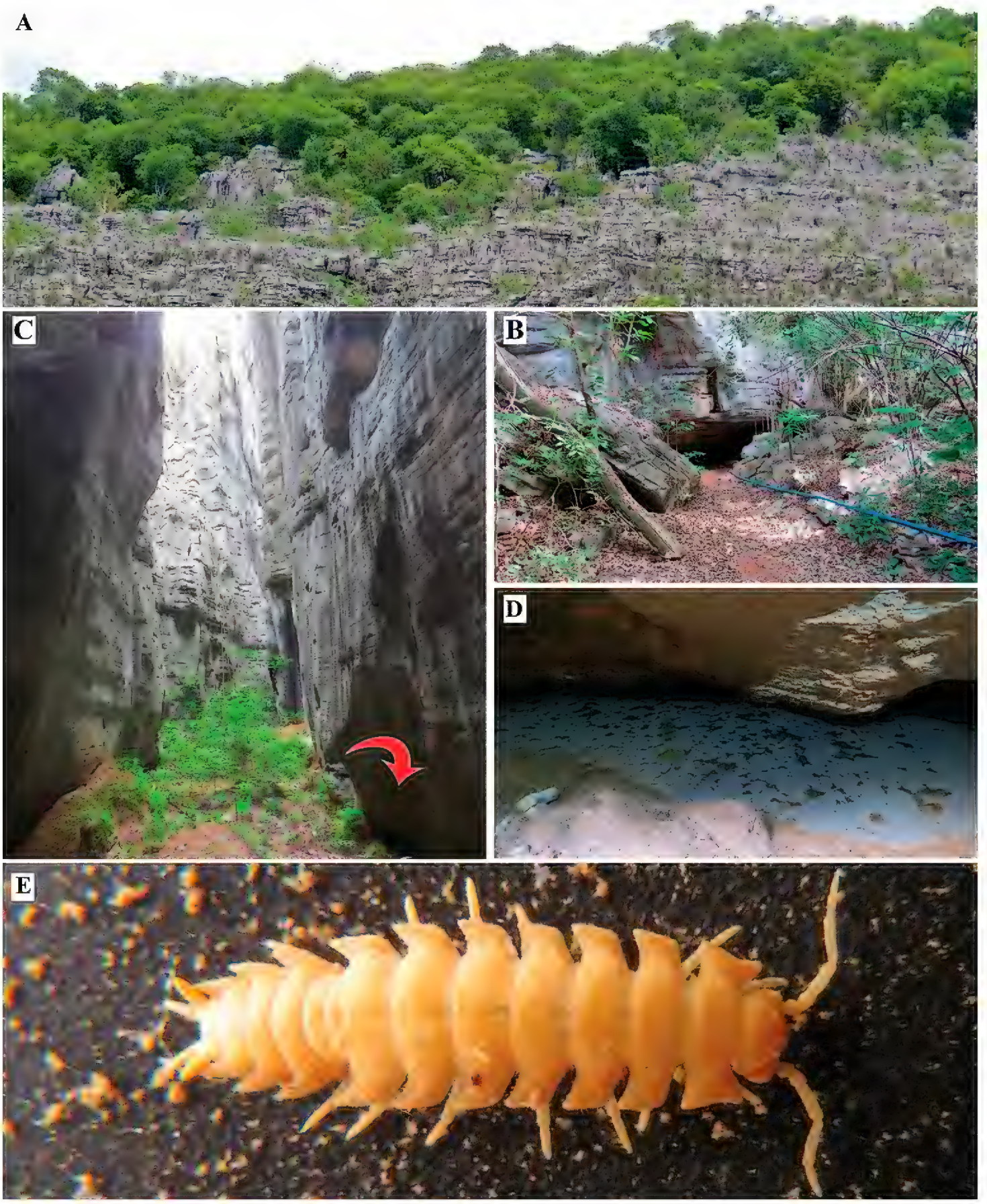

Figure 9. A external landscape of Lapa d'água do Zezé cave **B** vertical entrance of the cave **C** narrow passage inside the cave with a skylight, red arrow indicates the collection site **D** water table where the species was collected **E** living specimen of *Chaimowiczia uai* sp. nov. with approximately 8 mm.

entrance (main entrance, Fig. 9C) and at least two vertical openings. The cave presents perennial water bodies with different conditions. The first one comprises the only accessible part of the water table, a narrow passage in the base of a diaclasis (Fig. 9B) close to one of the cave's vertical openings (Fig. 9C). The second area comprises a very small drainage, apparently originated by the water table overflow. Some physical and chemical parameters of the water were measured during one visit (January 2015): dissolved

oxygen 3.46 mg/L, temperature 25.35 °C, pH 8.45, electrical conductivity 0.565 µS/cm, total dissolved solids 0.359 g/L. This cave also harbors two other stygobitic species and one troglobitic species: the amphipod *Spelaeogammarus uai* (Bastos-Pereira & Ferreira, 2017), which is easily observed in the water table (accessible through the small passage) and seldom at the small drainage; the isopod *Xangoniscus santinhoi* Cardoso, Bastos-Pereira, Souza & Ferreira, 2020b, which is only observed in the drainage; and the hydrometrid *Spelaeometra gruta* Polhemus & Ferreira, 2018. Considering the presence of the amphipod on the drainage, it is possible to infer that both water bodies are connected. Each species seems to present specific preferences. Only a few amphipods were observed in the drainage during several visits to the cave. They seem to avoid this area due to the water flow. Interestingly, specimens of *C. uai* sp. nov. were only found in the water table, sharing the habitat with amphipods, while no specimens were observed in the drainage (Fig. 9D, E). As mentioned for *C. tatus* sp. nov., *C. uai* sp. nov. seems to avoid other styloniscid isopods, which are quite abundant along the drainage and very rare at the water table. This apparent avoidance may have resulted from competition between species, and this certainly deserves further investigation. Organic debris is seasonally transported to the water table (during the rainy periods) due to the proximity to the vertical entrance. Accordingly, the observed organic matter is mainly composed of vegetal debris.

Local farmers have installed a gravitational pump inside the cave in order to drag water from the cave for consumption and irrigation (Fig. 9C) (Bastos-Pereira and Ferreira 2017). Hence, the drainage was partially altered and is disturbed by farmers, who periodically remove the sediment to allow water flow. Such intervention occurs with low frequency (once in a year, according to the farmer), and only in a few parts of the drainage. It does not seem to affect the cave communities, especially considering that a great part of the populations may be in inaccessible areas of the cave. Lastly, although the vegetation seems well preserved in the surroundings of the cave entrance, the original forests were severely altered in many areas around the outcrops and the landscape is mainly composed of pastures and crops.

Discussion

Chaimowiczia uai sp. nov. differs from *C. tatus* sp. nov. in having rounded antennal lobes on cephalon (*vs.* quadrangular in *C. tatus* sp. nov.), anterior portion of pereonite 1 epimera directed frontward (*vs.* outwards in *C. tatus* sp. nov.), pleonite 5 posterior margin surpassing distal margin of telson (*vs.* shorter than distal margin in *C. tatus* sp. nov.), and uropod endopod longer than exopod (*vs.* endopod as long as exopod in *C. tatus* sp. nov.).

Chaimowiczia gen. nov. was allocated into the subfamily Iuiuniscinae. Iuiuniscinae was created to include *Iuiuniscus iuiuensis* Souza, Ferreira & Senna, 2015, a species with unique behavior in Oniscidea: it builds semi-spherical shelters using clay. This behavior represents an evolutionary novelty that probably could support the subfamily as a clade (or support a least inclusive group in which this characteristic has arisen),

even if other possible species of Iuiuniscinae, such as the new species of *Chaimowiczia* gen. nov. described here, do not exhibit this characteristic.

Good character interpretation is essential to achieve more robust results in phylogenetic analysis. In taxonomy, primary homology hypotheses are made when taxa are comparatively described. It is not possible to start a phylogenetic analysis without resorting to descriptive works. Improvement of descriptive works such as Campos-Filho et al. (2019) did for *Iuiuniscus* and Taiti and Montesanto (2020) did for *Thailandoniscus* Dalens, 1989 is important. Morphological characters can indicate kinship, which may be investigated in future phylogenetic analyses. Thus, hypotheses of primary homologies provided in taxonomic works can be tested and confirmed (or not) as synapomorphies through phylogenetic analyses. Therefore, evolutionary reasonings should be developed in taxonomic works, in addition to character description. However, based on the premises mentioned, it is necessary to amend some arguments provided by Campos-Filho et al. (2019). The illustration provided by these authors for the male pleopod 2 endopod confirms what was established by Souza et al. (2015: 10): "the morphology of the distal part pleopod 2 endopodite of male... is in part similar to *Spelunconiscus*". Campos-Filho et al. (2019) suggested that such similarity might indicate kinship. This could invalidate Iuiuniscinae along with the similarity between the male exopod 3 of *Xangoniscus*, *Spelunconiscus,* and *Iuiuniscus*. Such similarity might be symplesiomorphic instead. The character states have not been established yet, so such similarities can be considered superficial until future phylogenetic analyses are carried out.

An important morphological trait observed in both species of *Chaimowiczia* gen. nov. are the rectangular-shaped lateral projections of pereonites epimera and somewhat acute in pleonites. These projections of pereonites and pleonites may be, another synapomorphies of Iuiuniscinae, in addition to the behavioral characteristic already mentioned. These lateral projections differ from the lateral projections in *Iuiuniscus*, especially considering the pleonites. The presence of morphological modifications (as some sort of spines) in subterranean crustaceans is well documented, and evidences associate them to mechanical defense mechanisms preventing predation (Jugovic et al. 2010; Souza et al. 2015). In some cases, exaggerated spines can be observed, like in the stenasellid *Acanthastenasellus forficuloides* Chelazzi & Messana, 1985 from Somalia, which shares the habitat with the troglobitic cyprinid predator fish *Phreatichthys andruzzii* Vinciguerra, 1824 (Messana et al. 2001). The distinct morphology observed in *Chaimowiczia* gen. nov. species may be related to this tendency. However, no potential predators were observed in their habitats. Hence, a question rises on the origin of these body lateral expansions.

Connell (1980) proposed the term "ghost of competition past" to describe one possible reason for observed niche differentiations among species. The theory suggests that competing species may present a lower fitness compared to species that avoids competition by occupying non-overlapping niches. As such, natural selection would favor the non-competing species since their population could increase in contrast to the competing species population. The observed differentiation might be the result from a past competition, the called ghost of competition past. Further studies tested such concept, observing that natural selection reduced interaction strength among co-occurring species, facilitating coexistence and population persistence (Steiner et al.

2007). Sheriff et al. (2010) proposed that the lack of recovery of reproductive rates of the snowshoe hare (*Lepus americanus* Erxleben, 1777) during the early low phase of the reproductive cycle may be a result from impacts of intergenerational, maternally inherited stress hormones caused by high predation risk during the population decline phases. Following the idea firstly presented by Connell (1980) and posteriorly corroborated by other authors, past predation could have selected some traits in a given population along a time period, but later this selective force may have ceased by the predator disappearance from the habitat. Despite the lack of any direct evidence (as a fossil record, for example), the morphology observed in *Chaimowiczia* gen. nov. may be a product of a "ghost predation past" in a period when the ancestor populations could be under a predator selective pressure. After ceased the selection, the morphology was kept in an intermediate state, which is currently observed as the pereonite and pleonites 3–5 epimera well developed in *Chaimowiczia* gen. nov. It is important to stress that such hypothesis deserves further investigation.

The here described genus raises to 17 the number of Styloniscidae living genera in the world, nine of them with occurrence in Brazil. Brazilian caves currently shelter 20 described species of Styloniscidae, while five other are found in epigean habitats (Campos-Filho et al. 2018; Cardoso et al. 2020a, b). The subterranean species deserves special attention regarding conservation actions due to their short-ranged geographical distribution (most of them are restricted to a single cave) and surrounding landscape being frequently threatened by anthropic activities.

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